

A system for drying agricultural crops and protecting them from insects typifies spinoffs in the fields of resources management and environmental control

Space Chambers for Crop Treatment

during a 1973 fire at the U.S. Government Records Center in St. Louis, Missouri, millions of documents were water-soaked by firefighting efforts. In the same city, McDonnell Douglas Corporation was operating large vacuum chambers to test spacecraft and components under the airless conditions they would encounter in space. As the government archivists pondered what to do about their irreplaceable records, a McDonnell Douglas engineer suggested an answer: dry them in a vacuum chamber, whose gentle microwave heating would leave them undamaged.

McDonnell Douglas undertook the job of developing a process for drying the records. It involved subjecting them to heat produced by microwave energy in an atmosphere of reduced pressure within the space chamber; the near-vacuum would lower the vaporizing point of the water in the documents, therefore drying temperature would be lower, allowing the papers to dry uniformly without curling or charring. It worked; the government was able to reclaim more than four million documents.

That started a chain of spinoff applications. McDonnell Douglas patented the drying process and started a sideline business of using its four vacuum chambers, when they were not engaged in space research, to dry valued articles soaked during floods and fires.

Looking to the broader potential of the drying process, McDonnell Douglas came up with a spinoff from the spinoff: a rapid, efficient

method of drying agricultural crops by means of a system called MIVAC™, a compression of Microwave Vacuum Drying System. In 1977, when the quest for new ways of conserving energy was in full swing, McDonnell Douglas won a contract from the Department of Energy for fabrication of a small experimental unit to demonstrate MIVAC's potential for reducing the great amounts of energy required for drying harvested crops; drying is an essential first step in crop processing, a means of making crops easier to ship and store. Most farmers use equipment powered by oil or natural gas to blow heated air over the produce. MIVAC, a distant cousin of the home microwave oven, dries more efficiently by means of electrically generated microwaves introduced to a crop-containing vacuum chamber; the microwaves remove moisture from the product very rapidly, reducing the time power is needed. Additionally, the low pressure atmosphere permits effective crop drying at much lower than customary temperatures, further reducing the energy requirement.

McDonnell Douglas teamed with Aeroglaze® Corporation, Raleigh, North Carolina, a major manufacturer of conventional drying equipment, to construct the experimental MIVAC. Built at a U.S.



Shown above is the first commercial scale MIVAC plant, a microwave/vacuum crop drying system that evolved from space simulation technology. The pilot MIVAC, located in Guntersville, Alabama, is operated by Continental Grain Company; the spinoff system was developed by McDonnell Douglas Corporation.

Department of Agriculture (USDA) station at Tifton, Georgia, the system demonstrated that MIVAC's promise went far beyond energy conservation. A big plus, its developers say, is that it does a better job of drying more easily damaged crops—rice, for instance. The hot-air blowing method may harden the outer coating, making it difficult for moisture to escape, causing cracked grains and loss of quality. MIVAC heats rice—and other products—evenly from the inside out, without hardening or damage. The system is environmentally clean; it has no polluting exhaust, its electric motors are virtually silent and, because MIVAC does not employ

hot air blowers as do conventional dryers, the chance of fire from the grain's dust and chaff is reduced. Change of product entails no change of equipment; at Tifton, the system successfully dried wheat, rice, peanuts, soybeans, corn, pecans, prunes and raisins.

The Tifton unit—still being operated by the USDA—demonstrated the practicality of microwave/vacuum drying for a wide range of agricultural products and encouraged McDonnell Douglas and Aeroglides to take the next step: developing and commercializing a larger-scale MIVAC. Under a cooperative agreement, McDonnell Douglas handles MIVAC design and

engineering, Aeroglides is responsible for marketing and manufacturing.

Under this agreement, the companies built the first commercial-scale MIVAC dryer at a plant operated by World Processing Division of Continental Grain Company in Guntersville, Alabama, where soybeans are processed into high protein animal feed and vegetable oil. Where the original demonstrator handled about 10 bushels an hour, the commercial prototype is capable of processing five tons of soybeans hourly—and that capacity can be doubled or trebled without redesigning the unit. Since it began operation in 1983, the Guntersville MIVAC has demonstrated significant reductions in energy use and additional savings because microwave drying eliminates certain steps necessary in conventional processing.

Last year, McDonnell Douglas advanced the technology one more step when—with the cooperation of the USDA—it developed a microwave sanitation process for use in MIVAC which kills insects and their larvae and eggs living in dried grains. Stored crops currently are sanitized with chemicals or nuclear radiation, both of which leave a contaminating residue that is carried into the processed food product; MIVAC leaves no residue. Unlike the MIVAC continuous drying process, sanitizing employs short bursts of intense microwaves that kill the insects but do not char the crop. McDonnell Douglas and Aeroglides are exploring the possibility of marketing the process as an alternative method of deinfesting grain.

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MIVAC is designed to dry crops more efficiently than the hot-air dryers now in use. Microwaves heat the product evenly at low temperature, removing moisture without damaging the crop. At right, a technician is testing a crop sample on a moisture meter to determine the correct drying time for a MIVAC run; below, he is adjusting the controls accordingly.

